

DEC STD 102-1 Environmental Standard for Computers and Peripherals—Temperature, Humidity, and Altitude Test Requirements

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ABSTRACT: This document defines environmental classifications and establishes the test requirements and conditions used to determine that products meet temperature, humidity, and altitude requirements. This revision includes new test criteria.

APPLICABILITY: This standard is mandatory for all hardware products designed, manufactured, or sold by Digital Equipment Corporation. Compliance is verified by formal testing and submittal of a formal test report to the Environmental Engineering group.

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Responsible Department:	Mechanical Technology Development
Responsible Person:	Frank Grimaldi
SMC Writer:	Eleanor Jacobi

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Frank Grimaldi - Mechanical Technology Development Group

Eric Williams - Standards Process Manager

Direct requests for further information to:

Frank Grimaldi
Use \$ VTX ELF for the latest location information.

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1 INTRODUCTION

This standard defines the environmental classifications for hardware products and describes the test requirements and conditions used to determine that products meet the requirements of their assigned classification.

For additional information about responsibilities, refer to *DEC STD 102-0 Environmental Standard for Computers and Peripherals—General Test Requirements*, subhead 1.3.

2 TEMPERATURE AND HUMIDITY REQUIREMENTS

Digital Equipment Corporation products must perform under a variety of environmental conditions. In the most general terms, these conditions may be defined by considering the following three categories of customer sites.

1. Class A Temperature and Humidity Environment

The Class A environment usually has dedicated air-conditioning, complete temperature and humidity controls, and environments maintained by tight control tolerances. These optimized environments are necessary for large electronic or process equipment; human comfort and costs are secondary considerations.

Examples of Class A sites are computer rooms, data centers, process areas, and so forth.

2. Class B Temperature and Humidity Environment

The Class B environment represents conditioned or marginally conditioned areas that may not have artificial cooling, but have heating. They usually have central, as opposed to dedicated, conditioning with moderate control tolerances capable of maintaining comfort levels.

These environments are optimized for human comfort. Cost requirements necessary for electronic and other equipment are secondary considerations.

Examples of Class B sites are personal offices, open offices, office equipment areas, workplaces that are air-conditioned or not air-conditioned, and so forth.

3. Class C Temperature and Humidity Environment

The Class C environment represents minimally conditioned or nonconditioned areas that may only have minimal heating. These areas have no cooling or humidity controls and may have only intermittent occupancy.

These environments are optimized for minimum cost. Human comfort and equipment requirements are secondary considerations.

Examples of Class C sites are storage or warehousing areas, light industrial areas, loading and receiving areas, minimally controlled workplaces, and so forth.

NOTE

Heavy industrial environments, outdoor exposures, and similar uncontrolled situations require temperature and humidity tolerances beyond those provided by this standard. Contact the standard owner for more information.

All Digital Equipment Corporation products must be capable of performing in Class A temperature and humidity environments.

Operating temperature and humidity tests are performed with the product operating throughout the specified exposures. Different operating temperature and humidity parameters are specified for each class of customer site environment. Operating tests are intended to demonstrate successful product operation at the extreme conditions of the class.

Nonoperating temperature and humidity tests are also specified. These exposures are applied to the nonoperating product that is prepared and packaged for shipment.

The exposures to the nonoperating temperature and humidity extremes verify the ability of product and packaging materials to withstand situations commonly encountered during transportation and short-term storage. Short-term storage is assumed to be sixty days or less. Environments for long-term storage of Digital products must be equivalent or better than those for Class C operating temperature and humidity conditions.

2.1 TEMPERATURE AND HUMIDITY TESTS—OPERATING

The operating temperature and humidity test parameters specified are the ambient conditions to be applied to Digital hardware products. These specifications identify test requirements to account for various product configurations that may be tested. Test parameters are identified for tests of individual cabinet assemblies, individual stand-alone or tabletop products, and for rack-mountable products tested in a typical rack-mounted configuration. Different test parameters are identified to allow separate testing of rack-mountable products out of a rack or cabinet assembly.

Digital hardware products will be classified and tested according to one of the following classes of temperature and humidity environments.

1. Class A Environment

- Temperature: 15°C (59°F) to 28°C (82°F)
- Relative Humidity: 20% to 80% with minimum dew point 2°C (36°F)

2. Class B Environment

- Temperature: 10°C (50°F) to 35°C (95°F)
- Relative Humidity: 10% to 90% with maximum wet bulb temperature 28°C (82°F) and minimum dew point 2°C (36°F)

3. Class C Environment

- Temperature: 5°C (41°F) to 50°C (122°F)
- Relative Humidity: 10% to 95% with maximum wet bulb temperature 32°C (90°F) and minimum dew point 2°C (36°F)

NOTE 1

All Digital hardware products will be tested to the limits of at least the Class A temperature and humidity environment.

NOTE 2

The maximum allowable operating temperatures for each class given are based on operation at sea level, barometric pressure 760 mm (29.92 inches) Hg.

Maximum allowable operating temperatures will be reduced by a factor of 1.8°C/1000 m (1°F/1000 ft) for operation at high altitude sites. For example, Class A, 8000 feet altitude, maximum temperature = 74°F. See Figure 5.

NOTE 3

Powered devices are assumed to have lower humidities than ambient conditions. This situation mitigates problems with media.

NOTE 4

The temperature ranges in this specification refer only to electronic products. The specified temperature ranges of nonelectronic products, such as media and toner, that must be used with some electronic products, may override the temperature ranges given here.

NOTE 5

Electrostatic discharge protection may be affected at humidities below 30%. Ambient temperatures above 35°C may cause media failure.

Wet bulb limits provide test envelopes more closely related to expected maximum environmental conditions. Meteorological surveys identifying one percent wet bulb data for ten years at international locations were used to determine reasonable wet bulb limits for our tests. (One percent data indicates the parameter value will be exceeded only one percent of the time.)

Minimum dew point limits represent the usual commercial chamber capabilities and, as such, define the minimum test envelope that can be readily verified. Product operation at lower dew point exposure is anticipated and is often verified as other contributing conditions permit (for example, favorable weather conditions).

2.1.1 Operating Temperature and Humidity Test Procedures

Operating temperature and humidity tests shall be performed in accordance with the following procedures.

2.1.1.1 Test Sample (50 Hz or 60 Hz)

Test items for these operating temperature and humidity tests should be chosen and tested as follows.

- For products having separate physical configurations for 50 Hz and 60 Hz operation, both the 50 Hz and 60 Hz configurations should be tested to the entire temperature and humidity test program.
- For products in which 50 Hz and 60 Hz operation is changeable, either the 50 Hz mode or the 60 Hz mode (whichever is convenient) should be tested to the entire temperature and humidity program. In addition, the other mode (50 Hz or 60 Hz) should be tested to the high and low temperature portions of the program, including variable voltage and overstress.

Two optional procedures are allowed for either of the cases described.

1. If a 60 Hz product is tested according to the entire operating temperature and humidity procedure, tests of a 50 Hz product may be limited to the high and low temperature conditions including variable voltage and overstress.

2. If complete thermal characterization is accomplished on the 50 Hz product according to the following requirements, the 50 Hz product may be approved without actual chamber testing at temperature extremes.

The requirements for procedure 2 are as follows.

- a. Temperature data is available for the operating 50 Hz product under conditions of normal room ambient temperature, including variable voltage extremes.
- b. Comparison of this data and temperature data obtained on a 60 Hz product specifically verifies that acceptable thermal operation of the 50 Hz product will occur at the limits of the class.
- c. The analysis and verification of acceptable operation of both the 50 Hz and 60 Hz product versions is formally documented and filed as part of the overall DEC STD 102 test program report package.

The above criteria and approval requirements for 50 Hz products applies regardless of whether the product has ac or dc air movers.

2.1.1.2 Product Operation Before and During Tests

Tests will be performed with the product performing diagnostic routines or actual operational tasks. It is required that product operation and diagnostics are verified and documented prior to the formal start of the temperature and humidity test conditions defined for the product class. This pretest verification will be performed for an error-free period of 4 hours minimum within the test chamber at a temperature of 23°C (73°F) and relative humidity between 40% and 60%. Data requirements of this pretest operation are the same as those required during test exposures and will be included in the final report.

Successful product operation requires that the product operate within specification throughout and following environmental exposures. It is intended that the definition of hard errors and soft errors, as well as acceptance limits on these product errors, will be provided by the product group in writing prior to the start of these tests. It is also intended that specific operator adjustments and allowable frequency of adjustment be described in writing prior to the start of these tests.

Demonstration of successful product operation is to be accomplished at each temperature and humidity condition specified for a period of 4 hours minimum (24 hours maximum) following temperature stabilization of the product in accordance with subhead 2.1.1.8.

Product printouts and any other output media records are to be retained and excerpts included in the formal test report to document product operation.

For certain cases in which continuous product operation throughout this period is unreasonable (due to diagnostic limitations, replacement of supplies, duty cycle specifications, and so forth), the requirement is to demonstrate successful operation for a total accumulated time as specified.

2.1.1.3 Adjustments to Products Under Test

Adjustments to the product under test that are operator adjustments may be acceptable, depending on the allowed criteria provided according to subhead 2.1.1.2 or included in the product specification. In the absence of a described allowable number of operator adjustments, a maximum of six operator adjustments will be permitted during the entire operating temperature and humidity program. Should the allowed number of operator adjustments be exceeded, the retest of the following three temperature and humidity conditions are required.

1. Repeat the condition in which the adjustment was made.
2. Repeat high temperature with variable voltage condition.
3. Repeat low temperature with variable voltage condition.

If the condition in which the adjustment was made is a variable voltage condition, it is to be repeated, as well as its corresponding nonvariable voltage condition and the variable voltage at the other temperature extreme.

Any adjustment made that is considered a service personnel adjustment will require repeating the entire operating temperature and humidity test program.

Any physical repair or replacement of any component, subassembly, or assembly of the product will require repeating the entire operating temperature and humidity test program. See subheads 2.1.1.5 and 2.1.1.6 for media or supply replacement.

2.1.1.4 Product Temperature Data Requirements

It is recommended that thermal characterization of 50 Hz and 60 Hz product examples be accomplished prior to these tests. These characterizations may be accomplished under normal laboratory ambient conditions. These characterizations may be based on information obtained during room ambient investigations normally performed by the product design or engineering group in their design evaluation testing.

There are no requirements for temperature data from within the product during these tests.

2.1.1.5 Media Performance and Replacement

All media (such as floppy disks, hard disks, magnetic tape, paper tape, Hollerith cards, and so forth) shall be included as part of these tests. In cases where the standard media becomes the limiting factor in classifying the temperature and humidity capabilities of a product or system, the project engineer or responsible person shall note this limiting factor and the product specification shall clearly state the limit imposed by the media.

If the standard media is the limiting factor when classifying and specifying product capabilities in excess of the standard media capabilities, tests using extended capability media must be performed to verify this fact. These tests demonstrate that product operational capabilities can exceed standard media limitations using special media. In addition to the entire operating temperature and humidity program with standard media, the tests with extended capability media are required at least at the high and low temperature conditions with voltage variation. This practice will allow an additional notation in the product specification to highlight this capability.

Media may be replaced during test conditions only if the expected media life has been exceeded; retest of the following conditions is required.

1. Repeat the condition in which the replacement was made.
2. Repeat high temperature with variable voltage condition.
3. Repeat low temperature with variable voltage condition.

If the condition in which the replacement was made is a variable voltage condition, it is to be repeated, as well as its corresponding nonvariable voltage condition and the variable voltage at the other temperature extreme.

2.1.1.6 Supplies and Expendables

All supplies or expendables (such as paper, ribbon, ink, and fluids) necessary for the operation of the product shall be included in these tests. These items may be replaced during testing only if the normal expected life or capacity is exceeded in the course of the tests.

2.1.1.7 Test Conditions

The temperature and humidity parameters applied to the product will consist of the specific conditions for the product temperature and humidity class tabulated in Table 1 or Table 2. These parameters correspond to the inflection points of the class temperature and humidity envelopes plotted in Figures 1 and 2; tests at these conditions demonstrate acceptable performance at all conditions within the class envelopes.

System configurations containing products of various class designations will be tested and specified at the environmental limits of the product having the minimum environmental capability.

2.1.1.8 Stabilized Test Condition

Stabilized conditions at each of the test points specified in Table 1 or Table 2 will be applied for four hours minimum. Stabilized temperature conditions will be said to exist when the product temperatures specified in subhead Section 2.1.1.7 (or mean values for fluctuating temperatures) do not change more than 2°C (4°F) within a 15 minute period.

2.1.1.9 Variable Voltage Tests Required

Line voltage variations will be applied according to subhead 2.1.6.

2.1.1.10 Rate of Temperature and Humidity Change Limits and Test Requirements

The rate of temperature change will be controlled during all operating temperature and humidity test condition transitions and product operation will continue to be verified.

The values for expected rate of temperature change increase with each environmental class. The tests defined in this standard will use values as defined below and in individual class test specifications.

Class	Rate of (dry bulb) Temperature Change
A, B	11°C/hr (20°F/hr) $\pm$ 2°C/hr (4°F/hr)
C	20°C/hr (36°F/hr) $\pm$ 2°C/hr (4°F/hr)

During all transitions the dew point will be kept well below the dry bulb temperature to prevent condensation on or in the product.

Successful product operation through all transitions of the operating temperature and humidity tests is required.

Rates of relative humidity change during operating and nonoperating temperature and humidity tests may reach 50% to 76% per hour, depending on specific test segment transitions.

2.1.1.11 Raw Data Requirements

The following data will be retained as part of the test data.

- All plots or tabulations of test chamber conditions
- All product printouts, photographs, or other product output media
- All notebook entries of chronological test events

2.1.1.12 Substitute Tests

Formal and documented temperature and humidity tests as defined in this standard are required regardless of prior or future tests (such as DMT, DVT, RQT, and so forth) on the product.

However, a test that meets all the criteria and specifications of these requirements will be acceptable even if performed in conjunction with other efforts. In all cases, this acceptance is contingent upon submittal of a complete formal test report to Environmental Engineering defining all necessary parameters, results, and conclusions.

2.1.1.13 Test Report Requirements

A formal test report is required to verify compliance with this standard. The test report must include all pertinent test data: identification, serial numbers, calibration dates of all test apparatus and equipment, explicit identification of product configuration tested including specific identification, serial numbers, and revision level of all options and accessories.

Test reports must also include specific identification of product diagnostics used and the specific pass or fail criteria defined by the product group.

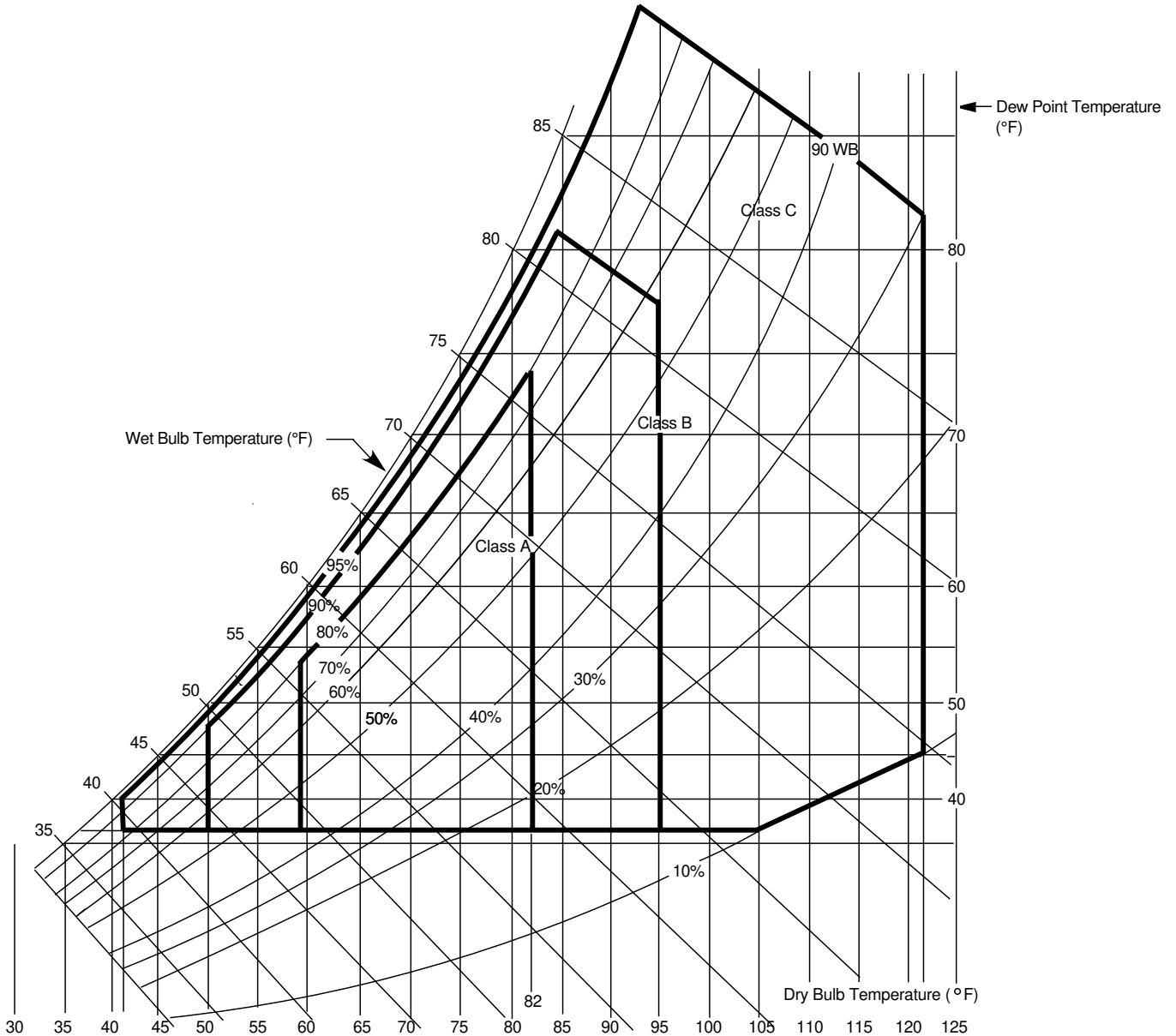
2.1.1.14 Test Chamber Criteria

The test chamber volume must be sufficiently larger than the product to allow adequate uniform circulation of ambient air. The ratio of chamber volume to product volume should be a minimum of 5:1. The minimum distance between any product surface and any chamber wall or internal surface will be 15 cm (6 in).

The test chamber circulation system must provide diffuse air flow to minimize effects on product inlet or exhaust flow.

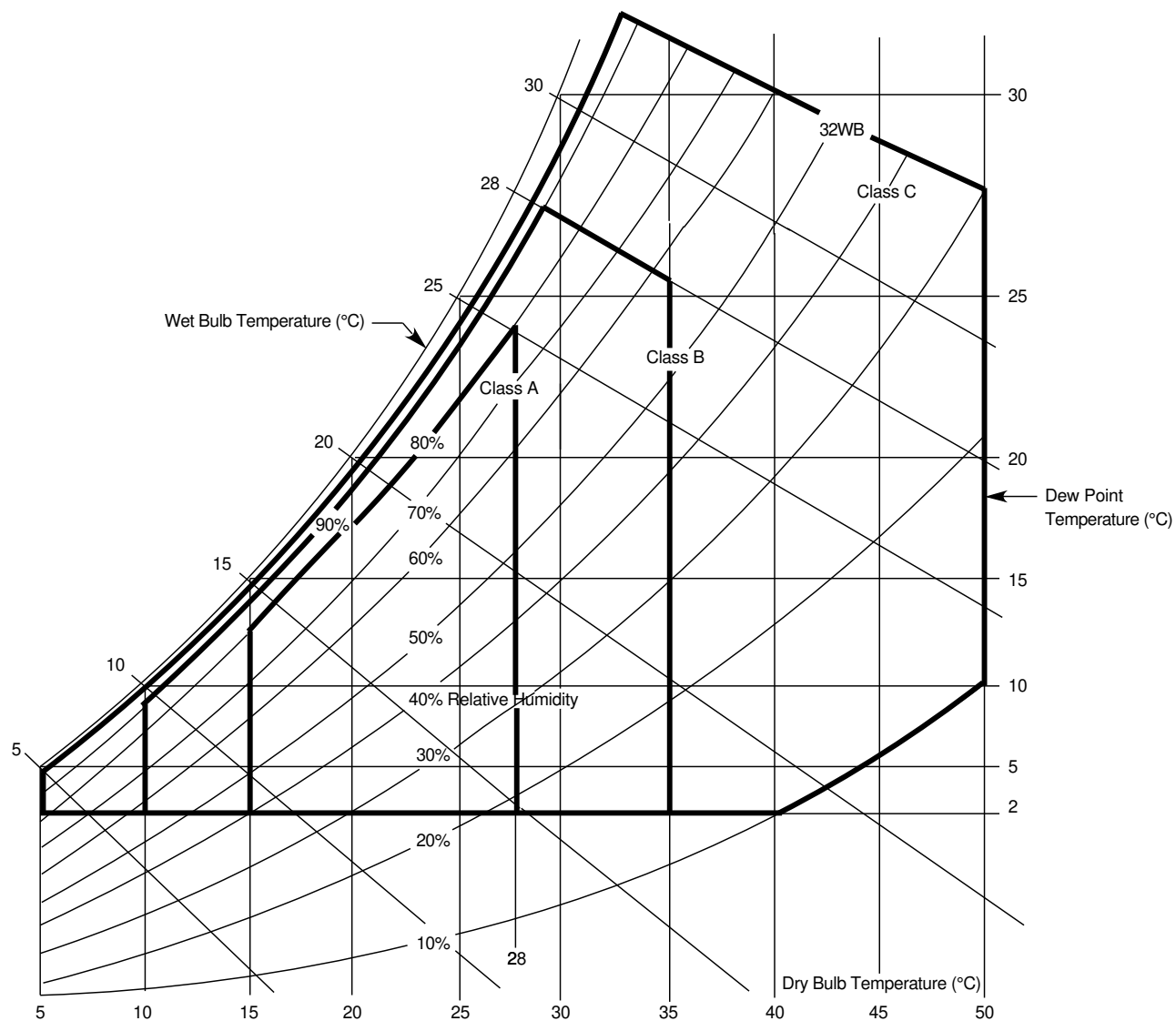
Test chamber conditions will be constantly monitored and permanent records (graphical plots or tabulated printouts) retained as part of the test data package.

Figure 1: Psychrometric Chart of Temperature °(F)/Humidity and Rate of Change Environments for Digital Hardware



Class	Rate of (dry bulb) Temperature Change
A, B ± 2°C/hr (4°F/hr))	11°C/hr (20°F/hr)
C ± 2°C/hr (4°F/hr))	20°C/hr (36°F/hr)

Figure 2: Psychrometric Chart of Temperature (°C)/Humidity and Rate of Change Environments for Digital Hardware



Class	Rate of (dry bulb) Temperature Change
A, B	11°C/hr (20°F/hr)
± 2°C/hr (4°F/hr)	
C	20°C/hr (36°F/hr)
± 2°C/hr (4°F/hr)	

Table 1: Test Conditions for Operating Temperature and Humidity Tests

Test Condition	Dry Bulb Temperature Degree		Wet Bulb Temperature Degree		Relative Humidity Percentage	Rate of Change of Temperature Degree/Hour	
	°C	°F	°C	°F		°C	°F
Class A Environment							
1	15	59	8.5	47.5	40	11	20
2	28	82	14	58	20	11	20
3	28	82	25	77	80	11	20
4	15	59	13	55.5	80	11	20
Class B Environment							
1	10	50	6	43.5	60	11	20
2	35	95	16	60	10	11	20
3	35	95	28	82	58	11	20
4	29	84	27.5	81.5	90	11	20
5	10	50	9	48.5	90	11	20
Class C Environment							
1	5	41	4	39	84	20	36
2	39	102	18	64	10	20	36
3	50	122	24	75	10	20	36
4	50	122	32	90	29	20	36
5	33	92	32	90	92	20	36
6	5	41	4.7	40.5	95	20	36

The rate of temperature change is the specified rate of dry bulb temperature change required during all transitions (see subhead 2.1.1.10). Dew point must be kept well below the actual dry bulb temperature to prevent condensation in or on the product during transitions.

NOTE

Pretest requirements are nominal temperature 23°C (73°F) and relative humidity 40% to 60%.

These test conditions apply to stand-alone products (tabletop or freestanding, subhead 2.1.2), stand-alone systems (rack-mounted, freestanding, tabletop, subhead 2.1.3), and rack-mountable products normally cooled with air external to the cabinet and tested separately (subhead 2.1.4.2).

2.1.2 Individual Products (Tabletop or Freestanding)

Individual tabletop or freestanding products that are neither intended nor capable of being rack-mounted in a cabinet or other enclosure with other products will be tested to the environmental conditions stated for the appropriate product class. Refer to Table 1. The products must be tested in the specific configuration deemed most demanding for cooling. These tests must be performed with all panels and covers in place and the product should contain the maximum number of options or modules allowed in the product. Options and modules selected should provide a test configuration that represents the most demanding situation regarding heat load and power dissipation.

2.1.3 Stand-Alone Products (Rack-Mounted, Freestanding, Tabletop)

Operating temperature and humidity tests of stand-alone products will be performed at the environmental conditions stated for the appropriate product class. Refer to Table 1. These tests must be performed with all panels and covers in place, and any cabinet or enclosure must contain the maximum number of products expected in the worst case configuration.

Configurations containing products of various class designations will be tested and specified at the environmental limits of the product having the minimum environmental capability.

2.1.4 Rack-Mountable/Add-On Products—Tested Separately

The following subheads describe rack-mountable add-on products that are tested separately.

2.1.4.1 Rack-Mountable Products Normally Cooled with Internal Cabinet Air

Operating temperature and humidity tests may be performed on individual *boxes* intended for use as rack-mounted items, provided the maximum test conditions are increased to account for the in-cabinet temperature rise expected when the product is rack-mounted in a product. Refer to Table 2.

An allowance of 10°C (18°F) temperature rise over the maximum ambient temperature conditions of the appropriate class has been made for boxes intended for mounting in cabinets or racks.

Options must be tested in the specific chassis configuration(s) deemed most demanding for cooling. Accordingly, when a rack-mountable product (which in its normal configuration receives its cooling air from within the containing product cabinet) is tested separately, the maximum operating temperature conditions applied to this unmounted product will be increased by 10°C (18°F) relative to the requirements for the class of environment identifying the product in which the product is to be used. Table 2 contains this adjustment.

It is intended that the test program outlined in this standard will be applied to a test item that is a representative sample of the product to be sold. The test procedures in subhead 2.1.4 are intended to address cases when assembly of a representative product sample is either not possible or not practical.

A default value of 10°C (18°F) for internal cabinet temperature rise when testing a rack-mountable add-on product provides a conservative evaluation for any product.

If a comprehensive, quantitative thermal analysis for the specific product predicts that a cabinet temperature rise lower than the default value of 10°C (18°F) will be present in the actual worst case configuration, the formal tests of that rack-mountable add-on product may use this predicted temperature rise rather than the default temperature rise specified here and in Table 2.

In this case, a revised Table 2 must be generated which incorporates the lower maximum dry bulb temperature values, and the revised wet bulb and relative humidity values that will result.

Table 2: Test Conditions for Operating Temperature and Humidity Tests of Add-On Products Normally Cooled with Internal Cabinet Air

Test Condition	Dry Bulb Temperature Degree		Wet Bulb Temperature Degree		Relative Humidity Percentage	Rate of Change of Temperature Degree/Hour	
	°C	°F	°C	°F		°C	°F
Class A Environment							
1	15	59	8.5	47.5	40	11	20
2	27	80	14	57	20	11	20
3	38	100	21	69	20	11	20
4	38	100	25	77	62	11	20
5	28	82	25	77	80	11	20
6	15	59	13	55.5	80	11	20
Class B Environment							
1	10	50	6	43	55	11	20
2	45	113	21	70	10	11	20
3	45	113	28	82	28	11	20
4	29	84	27.5	81.5	90	11	20
5	10	50	9	48.5	90	11	20
Class C Environment							
1	5	41	4	39	84	20	36
2	39	102	18	64	10	20	36
3	60	140	29	85	10	20	36
4	60	140	32	90	14	20	36
5	33	92	32	90	92	20	36
6	5	41	4.7	40.5	95	20	36

The rate of temperature change is the specified rate of dry bulb temperature change required during all transitions (see subhead 2.1.1.10). Dew point must be kept well below the actual dry bulb temperature to prevent condensation in or on the product during transitions.

NOTE

Table 2 conditions only apply to rack-mountable items that are cooled with internal cabinet air and are tested separately, without a cabinet. See subhead 2.1.4.1 for alternate procedures.

NOTE

Pretest requirements are nominal temperature 23°C (73°F) and relative humidity 40% to 60%.

2.1.4.2 Rack-Mountable Products Normally Cooled with Air External to Cabinet

A rack-mountable product, which in its normal configuration receives its cooling air from directly outside the system cabinet, need not have the increased temperature specified in subhead 2.1.3 applied if tested separately.

These products will be tested to the environmental conditions stated for the appropriate product class. Refer to Table 1.

2.1.5 Subassemblies or Modules

To meet the requirements of this standard, subassemblies and modules must be tested and evaluated while installed in a host product. The host product chosen for these tests should represent the most demanding configuration expected of the subassembly or module.

2.1.6 Line Voltage Variation Requirements

At the high and low temperature extremes of the environmental class, the product will be operated at three values of line voltage: nominal, high, and low extremes. Operations at each line voltage value will be 1-1/2 hours minimum after the stabilized temperature condition is reached.

To test at the low voltage condition, turn on the power with the low voltage value preset as opposed to applying full voltage and then reducing power.

The specific voltage requirements are identified in *DEC STD 122-0 AC Power Line Standard: Design Requirements and Guidelines*.

2.1.7 Pass or Fail Criteria for Operating Temperature and Humidity Tests

Successful product operation for all conditions of the appropriate temperature and humidity class are required without any product modification or adjustments except as noted in subheads 2.1.1.3, 2.1.1.5, and 2.1.1.6.

Run time will be four hours minimum and 24 hours maximum after product temperature stabilization at each condition. Transition times are not included in the four hour minimum run time, but successful operation is required during all transitions and the temperature rate of change criteria are to be maintained according to subhead 2.1.1.10.

The specific criteria for acceptance are as follows.

- The product must operate successfully throughout all specified temperature and humidity conditions including all temperature and humidity transitions. All hard and soft errors must be documented and must be within the error rate criteria established by the product group.
- There must be no evidence of any physical defects or physical failures during or following these tests.

The following descriptions identify specific product defects or failures that may be experienced during temperature and humidity testing.

Those people responsible for evaluating product performance and determining product acceptance following environmental tests should closely examine test items to identify if any of these specific types of defects and failures are present.

- a. Parts binding, bowing, distorting, deteriorating, cracking, or otherwise failing from differential expansion of dissimilar materials.
- b. Swelling of materials due to moisture absorption causing binding, misalignment, jamming of moving parts, or other operational problems or physical damage.
- c. Shrinking or contraction of materials due to evaporation of internal moisture content causing looseness, misalignment, or jamming of moving parts.
- d. Discoloring, bowing, cracking, embrittlement, or crazing of parts.
- e. Binding of moving parts due to corrosion or fouling of lubricants.
- f. Lubricants becoming less viscous and leaking.
- g. Loss of lubrication due to increased viscosity of lubricant.
- h. Gaskets or closure seals or electrical connections deteriorating or displaying permanent set.
- i. Stiffening or softening of shock mounts.
- j. Condensation resulting in corrosion or failure of a part, or visual contamination especially at electrical connections.
- k. Electrical shorts due to condensation.
- l. Accelerated chemical reactions resulting in corrosion of parts and impairment of electrical connections.
- m. Degradation of electrical and thermal properties in insulating materials, loss of strength, and other changes in mechanical properties causing operational failures.
- n. Deterioration of hygroscopic materials.
- o. Degradation of image transmission through glass or plastic optical elements causing operational or perceived quality problems.
- p. Operational problems due to static discharges.

2.1.8 Overstress Temperature Test

NOTE

Successful performance during any or all portions of this overstress test is specifically not required for compliance with this standard. However, overstress exposure and documentation of results is a requirement for compliance to this standard.

Following successful completion of the requirements for the operating temperature and humidity tests, and preferably following completion of all other requirements of this specification, performance of an overstress temperature test is required to identify a performance guard band for the product.

To perform this test, expose the operating product to a temperature 5°C (9°F) above and below the limits specified for the product class. This exposure will be limited to four hours maximum for each temperature.

Although the appropriate maximum wet bulb limit for the product class and minimum dew point of 2°C (36°F) are intended as limits for the relative humidity conditions, these conditions may be exceeded during the testing as a result of practical test chamber limitations. In the case of Class C low temperature overstress, no humidity controls will

be possible since this condition is at the freeze point. Test chamber wet bulb measurement systems need to be drained before performing this test. There is no minimum time required for voltage extremes in overstress tests.

To test at the low voltage condition, turn on the power with the low voltage value preset as opposed to applying full voltage and then reducing power.

Operation at line voltage extremes should be verified during the high and low temperature overstress test.

Data should include the actual temperature and humidity conditions applied and the time and description of any operational problems experienced by the product.

2.2 TEMPERATURE AND HUMIDITY TESTS—NONOPERATING

The nonoperating temperature and humidity test consists of exposures of temperatures between -40°C (-40°F) and 66°C (151°F) and of relative humidities up to 95%.

The nonoperating temperature and humidity test consists of two cold cycles and two hot cycles, as shown in Figure 3. The exposures to these nonoperating temperature and humidity extremes are meant to verify the abilities of product and packaging materials to withstand situations commonly encountered during transportation and associated short-term storage. Short-term storage is assumed to be sixty days or less. Humidity conditions actually produced during the temperature transitions specified in these tests can produce condensation in or on the test item. Environments for long-term storage in Digital are required to be equivalent or better than Class C operating temperature and humidity conditions.

The testing described in this document is not intended to validate temperature or corrosion resistance of materials, finishes, and plating by system level qualification tests. The nonoperating temperature and humidity test is solely an evaluation of the packaged product's suitability for the shipping environment. It is not necessarily a test of a material's resistance to corrosion in the user environment.

The protective finishes specified in *DEC STD 092-4 Finish and Color Standard—Approved Finish Specifications* have adequate corrosion resistance for Digital products, both in the end use and shipping environments. They may be used in a product without revalidating their ability to withstand the temperature and humidity test in this standard.

Finishes and platings not listed in the *Finish and Color Standards Manual* must be evaluated at the component level. They should be evaluated in testing separate from the product tests specified in this document. There is no requirement to repeat the corrosion testing of materials or finishes in a complete product or subassembly. The interaction of materials and finishes such as galvanic corrosion or swelling of plastics due to moisture, should be evaluated with representative parts or materials samples. Materials and finishes should be evaluated during product design not during qualification testing of the complete product.

Tests in this standard may be used to evaluate resistance to temperature, humidity, and condensation as part of the evaluation of corrosion resistance of parts or finishes. Separate component evaluations may be included during tests of complete systems or subassemblies. Nonoperating temperature and humidity exposure described in this document should be used to check for temperature, humidity, and corrosion resistance of parts, as specified in the *Finish and Color Standards Manual*.

NOTE

Test of desiccated shipping packages that conform to *DEC STD 045-1 Packaging Products for International Shipment—Design Requirements and Procedures* are not required. Since nonoperating exposures are not applied to these products, designers must validate the temperature capabilities of parts and materials with component or subassembly tests.

2.2.1 Cold Cycle Test Requirements (Two Cycles Required)

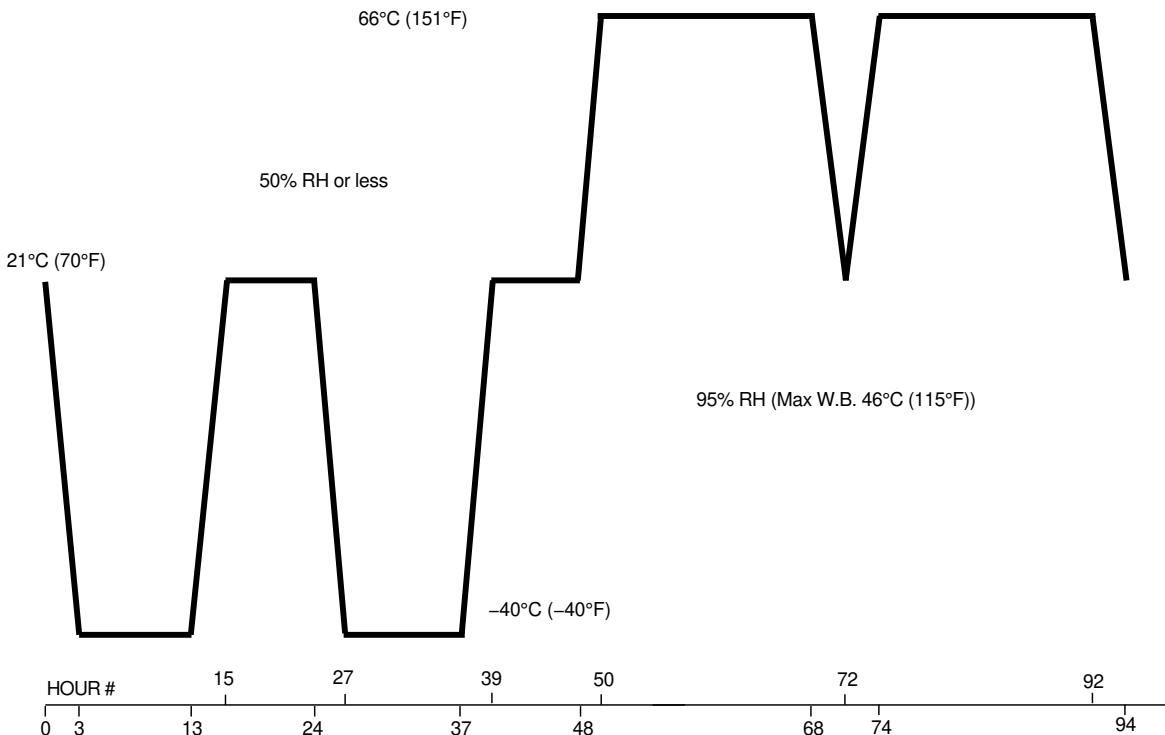
The cold cycle test requirements are:

1. Reduce chamber temperature from 21°C (70°F) to -40°C (-40°F) in three hours.
2. Dwell at temperature -40°C (-40°F) for 10 hours.
3. Raise chamber temperature to 21°C (70°F) and 50% relative humidity or less in two hours.
4. Dwell at temperature 21°C (70°F) and 50% relative humidity for nine hours.

NOTE

Humidity conditions actually produced during the temperature transitions specified can produce condensation in or on the test item. These occurrences are acceptable in these tests.

Figure 3: Nonoperating Temperature and Humidity Test Cycles



2.2.2 Hot Cycle Test Requirements (Two Cycles Required)

The hot cycle test requirements are:

1. Raise chamber temperature from 21°C (70°F) to 66°C (151°F) in two hours.
2. Dwell at temperature 66°C (151°F) for 18 hours.
3. Maintain relative humidity at 95% throughout hot cycle, limited by maximum wet bulb temperature of 46°C (115°F).
4. Reduce chamber temperature from 66°C (151°F) to 21°C (70°F) in four hours.

NOTE

Humidity conditions actually produced during the temperature transitions specified can produce condensation in or on the test item. These occurrences are acceptable in these tests.

2.2.3 Nonoperating Temperature and Humidity Test Procedures

Nonoperating temperature and humidity tests shall be performed in accordance with the following requirements.

2.2.3.1 Test Samples

Stand-alone products or systems that are shipped on skids or on enclosure castors will be tested using all protective packaging material (polybag, wraparound, and so forth) specified for shipment of the product.

Products that are shipped in individual shipping packages will be tested using the specific package, packaging materials, and procedures specified for the product.

NOTE

No tests of desiccated shipping packages are required.

2.2.3.2 Product Operation Before and After Tests

Product operation is required before and after this nonoperating temperature and humidity test program. Product operation will be verified with the product performing diagnostic routines or actual operational tasks. It is required that the product operation be verified prior to the formal start of these nonoperating temperature and humidity tests. This pretest verification will be performed for a period of four hours minimum.

The pretest verification will be performed with the test chamber at a temperature of 23°C (73°F) and relative humidity between 40% and 60%. The product must also demonstrate successful operation following the nonoperating temperature and humidity test exposure. The definition of hard errors, soft errors, and acceptance limits on these product errors should be provided in writing by the product group prior to the start of these tests. The product should be conditioned at normal room temperature and humidity conditions for a minimum of two hours prior to operational tests. It is also intended that specific operator adjustments and allowable frequency be described in writing prior to the start of these tests.

Product printouts and any other output media records are to be retained and excerpts included in the formal test report to document product operation.

2.2.3.3 Adjustments to Product

Operator adjustments to the product are acceptable depending on the allowed criteria provided in subhead 2.2.3.2 or in the product specification.

2.2.3.4 Product Temperature Data Requirements

There are no requirements for temperature data from within the product or shipping package during these nonoperating temperature and humidity tests.

2.2.3.5 Media

All media, such as tapes, disks, and paper, will be subjected to the same test conditions as the product regardless of environmental restrictions that may be specified for the media. The media and its performance in the product will be tested to the environmental requirements when packaged for shipment. Refer to subhead 2.2.4.2 for requirements for media with vendor specifications that limit exposures of temperature or humidity to levels below those required by this standard.

2.2.3.6 Supplies or Expendables

Any supplies or expendables specifically required within the product or its package during shipping are to be included in these tests. Refer to subhead 2.2.4.2 for requirements for supplies with vendor specifications that limit exposures of temperature or humidity to levels below those required by this standard.

2.2.3.7 Test Conditions

The temperature and humidity conditions applied to the product will be in accordance with Figure 3 and detailed in subheads 2.2.1 and 2.2.2.

2.2.3.8 Stabilized Test Condition

Not applicable.

2.2.3.9 Variable Voltage

Not applicable.

2.2.3.10 Rate of Temperature and Humidity Change Limits

Refer to subheads 2.2.1 and 2.2.2 and to Figure 3.

2.2.3.11 Raw Data Requirements

As part of the test data, retain all plots or tabulations of test chamber conditions, product printouts or other product output media, notebook entries of chronological test events, and all photographs.

2.2.3.12 Substitute Tests

As defined in this standard, formal and documented temperature and humidity tests are required regardless of prior or future tests on the product (such as DMT, DVT, RQT, and so forth). However, a test that meets all the criteria and specifications of these requirements will be acceptable even if done in conjunction with other efforts. In all cases, this acceptance is contingent upon submittal of a complete formal test report to Environmental Engineering defining all necessary parameters, results, and conclusions.

2.2.3.13 Test Report Requirements

A formal test report is required to verify compliance with this standard. The test report must include all pertinent test data: identification, serial numbers, calibration dates of all test apparatus and equipment, and explicit identification of product configuration tested, including specific identification, serial numbers and revision level of all options and accessories.

2.2.3.14 Test Chamber Criteria

The test chamber volume must be sufficiently larger than the product to allow adequate uniform circulation of ambient air. The ratio of chamber volume to product volume should be a minimum of 5:1. Test chamber conditions will be constantly monitored and permanent records (graphical plots or tabulated printouts) retained as part of the test data package.

2.2.4 Pass or Fail Criteria for Nonoperating Temperature and Humidity Tests

The following subheads discuss the pass or fail criteria for nonoperating temperature and humidity tests.

2.2.4.1 Physical Degradation or Defects

Following test exposure, the packaging materials will be removed, the product will be examined, and any physical degradation or defects will be explicitly noted. Operation of the product within specifications will also be verified. Product operation must be verified before any disassembly of the product and before the product is opened for inspection.

The specific criteria for acceptance are as follows.

- Successful product operation following the specified nonoperating temperature and humidity exposure is always required.
- No evidence of any significant physical defects or failures that a typical customer would find objectionable.

The exposures to these nonoperating temperature and humidity extremes are meant to verify the abilities of product and packaging materials to withstand situations commonly encountered during transportation and associated short-term storage. Short-term storage is assumed to be 60 days or less. Humidity conditions actually produced during the temperature transitions specified can produce condensation in or on the test item.

When parts (such as motors, brackets, and heads) fail, retests may be done on the individual parts (rather than requiring retest of the entire product). Some failures (cases warping or delaminating) may require retests of major subassemblies or of the entire product.

Any hard or soft operational errors experienced during post-test operational verification that are in excess of the failure criteria defined by the product group, in accordance with subhead 2.2.3.2, constitute failure.

For cases of minor corrosion and successful operation of the product, the product is acceptable. The general rule is that some aspects of product appearance may be degraded by the test but overall appearance must be at a level that a typical customer would find acceptable.

Examples of acceptable minor corrosion are:

- Light haze or tarnishing
- Fingerprints
- Light discoloration or streaking of metal surfaces
- Small amounts of powdery residue
- Inconspicuous rusting at corners or edges not affecting operation of product

These appearance imperfections are often seen where liquid water had been present during the humidity exposure, and their severity may depend on the amount of water condensed.

Examples of corrosion that is not acceptable include:

- Visible corrosion on exterior surfaces.
- Evidence of delamination of plating or paint layers.
- Clear indication of corrosion on flat surfaces. For plated or painted metal parts, rusting or corrosion of the base metal constitutes a failure except for minor rusting noted above.

Parts warping or permanently deformed to a visibly objectionable degree constitute a failure.

Shipping materials that adhere to the product surfaces constitute a failure. Shipping or cushioning material degradation and separation, especially at glue joints, constitute a failure. Media failure criteria and the resolution procedure is defined in Figure 4.

2.2.4.2 Policy for Systems Which Incorporate Products or Supplies with Lower Than the Required 95% Relative Humidity Limit

Vendor specifications for some media and supplies may limit exposures of temperature or humidity to levels below those required by this document.

In some cases, such as during transportation, the vendor limits are less severe than conditions that may exist in actual situations.

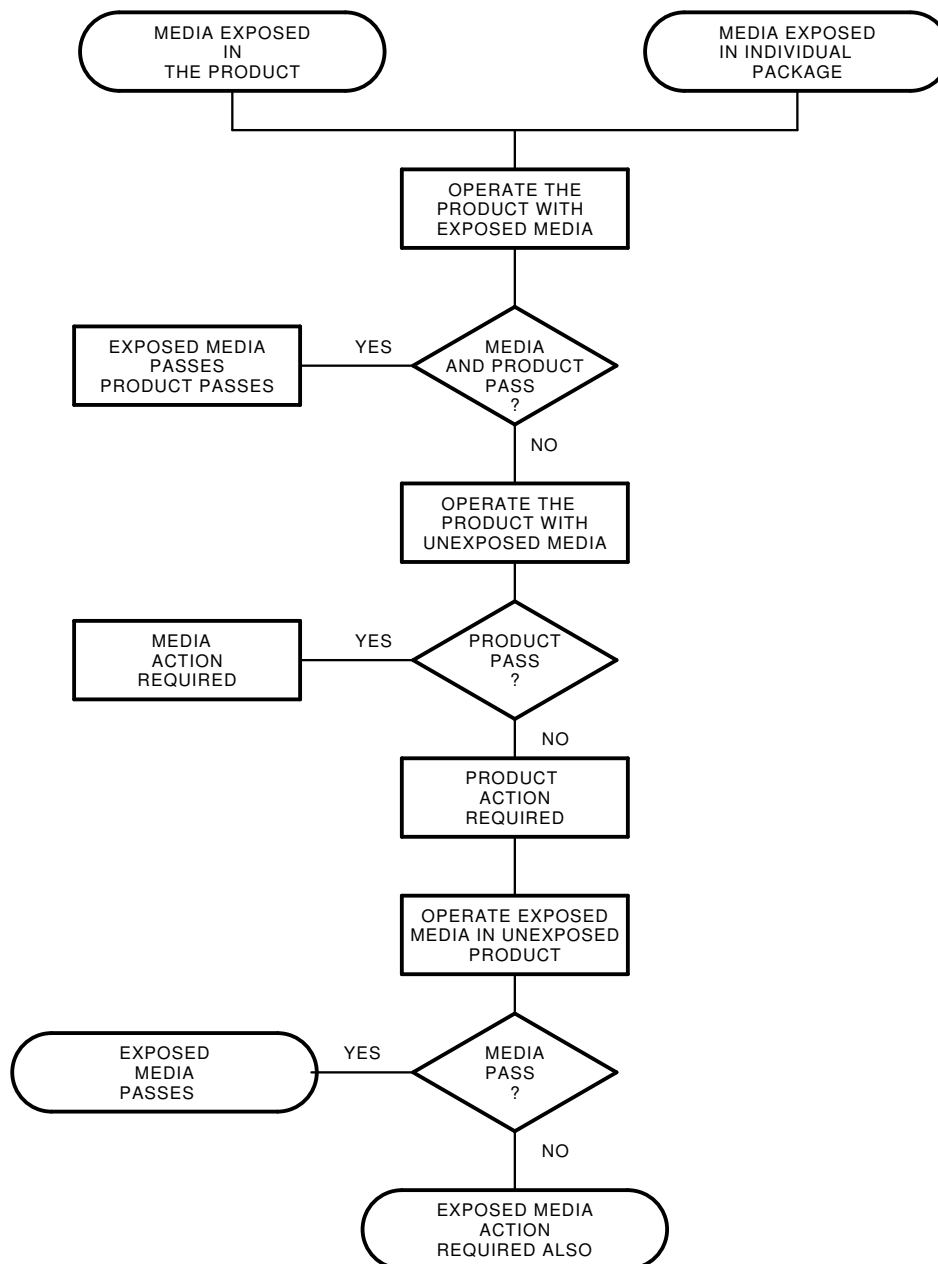
In cases where a specification does not meet the requirements of this document, the following apply.

- a. If the product decision is that no action will be taken to investigate actual performance capabilities or to correct the noncompliance to the given requirements, then a formal waiver to DEC STD 102 is required. The standard owner may or may not endorse the waiver depending on the specific details.

- b. If the product is tested and passes the given requirements, a waiver to this document is not required. This applies regardless of whether the Digital product adopts this specification or the vendor specification.

If the product fails the tests specified in this document, a formal waiver is required. The standard owner may or may not endorse the waiver depending on the specific details.

Figure 4: Media Failure Criteria



NOTE

Exposed means subjected to nonoperating temperature and humidity test.

3 ALTITUDE REQUIREMENTS

Altitude tests are performed on Digital products to demonstrate capability for enduring pressure changes associated with shipping environments and to demonstrate performance capabilities at locations where high ground elevations exist.

Operating altitude tests are described for altitude chambers with and without temperature control.

Figure 5 shows the maximum operating temperatures allowed for Digital products at locations of high ground elevation to account for reductions in air density.

3.1 ALTITUDE TEST PROCEDURES

The following procedures apply, as noted, to operating and nonoperating altitude tests.

3.1.1 Test Samples (50 Hz and 60 Hz)

Test items for operating altitude tests should be chosen and tested as follows.

- For products having separate physical configurations for 50 Hz and 60 Hz operation, the 50 Hz configuration should be tested.
- For products in which 50 Hz and 60 Hz operation is changeable, the 60 Hz mode should be tested and, in addition, thermal data in the 50 Hz mode of operation should be recorded.

The procedure described below is allowed for either of the above cases.

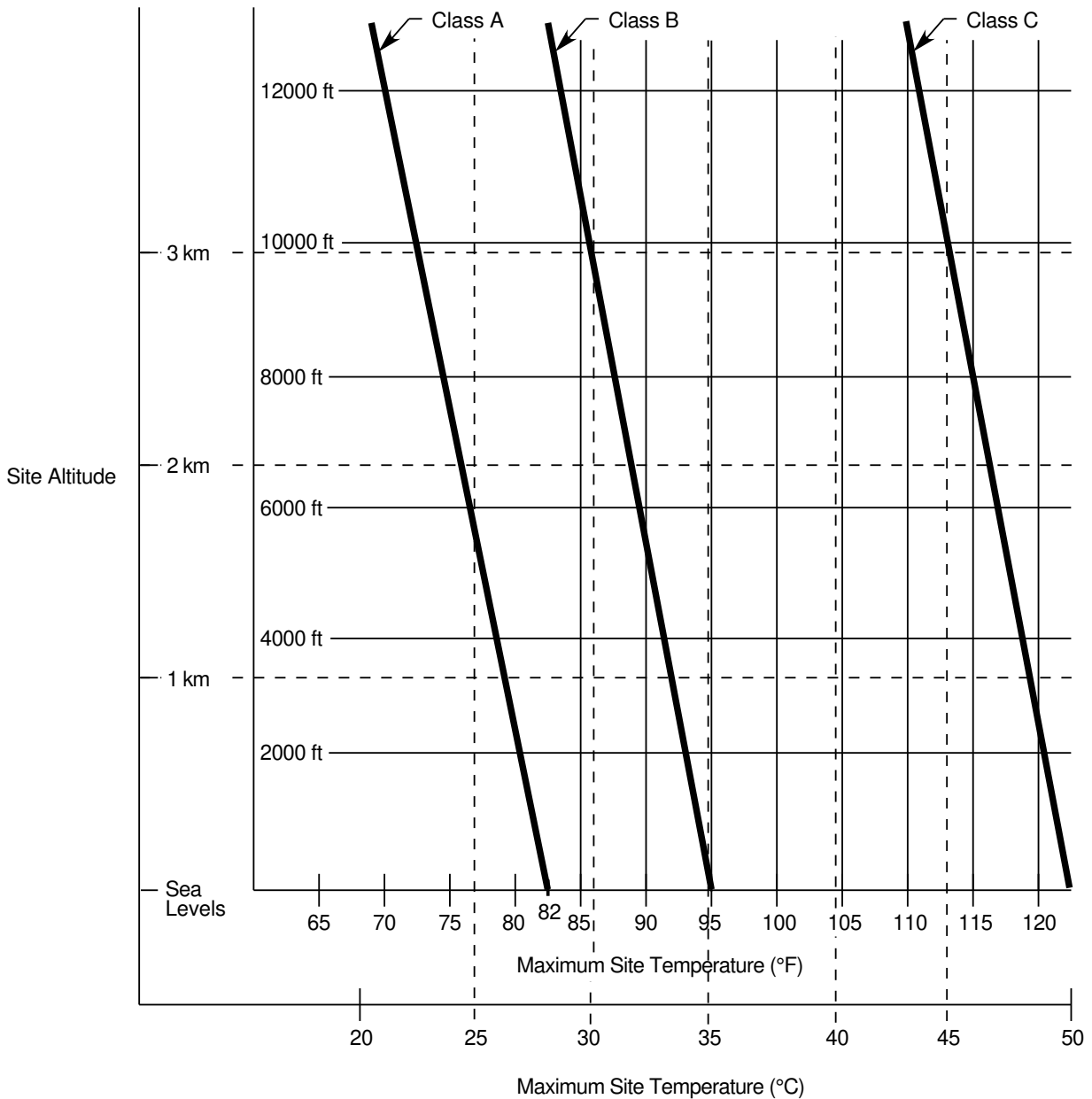
If complete thermal characterization is accomplished on the 50 Hz product according to the following evaluation, the 50 Hz product may be approved without actual altitude chamber testing. The requirements for this analytical evaluation are described in the following paragraphs.

- a. Temperature data is available for the operating 50 Hz product under conditions of normal room ambient temperature.
- b. Comparison of this data and temperature data obtained from a 60 Hz product specifically verifies that acceptable thermal operation of the 50 Hz product will occur at the limits of the class.
- c. The analysis and verification of acceptable operation of both the 50 Hz and the 60 Hz product versions is formally documented and filed as part of the overall test program report package required for this standard.

The criteria and approval requirements for 50 Hz products apply whether the product has ac or dc air movers.

For nonoperating altitude tests, either the 50 Hz or 60 Hz test sample is acceptable. It is not required to test each sample. The use of packaging materials during the nonoperating altitude test is optional.

Figure 5: Maximum Operating Temperature Versus Altitude



3.1.2 Product Operation Before, During, and After Tests

Operating altitude tests will be performed with the product performing diagnostic routines or actual operational tasks. It is required that product operation and diagnostics are verified and documented prior to the formal start of the operating altitude test.

This pretest verification will be performed for an error-free period of four hours minimum. The pretest verification shall be performed within the test chamber at laboratory ambient altitude and at a temperature of 23°C (73°F) and relative humidity between 40% and 60%. It is required that the laboratory altitude be recorded as part of the test data.

Data requirements of this pretest operation are the same as those required during test exposures and shall be included in the final report. Successful product operation requires that the product operate within specification throughout the test and following the application of the specified altitude exposures.

The definition of hard errors, soft errors, and acceptance limits on these product errors should be provided in writing by the product group prior to the start of these tests. The specific operator adjustments and allowable frequency of adjustment should also be described in writing prior to the start of these tests.

Demonstration of successful product operation is to be accomplished at the operating altitude condition for a duration as defined in subhead 3.2.1.

Product printouts and any other output media records are to be retained and excerpts included in the formal test report to document product operation.

For certain cases in which continuous product operation throughout this period is unreasonable (due to diagnostic limitations, replacement of supplies, duty cycle specifications, and so forth), the requirement is to demonstrate successful operation for a total accumulated time as specified.

Product operation is not required during the exposure to the nonoperating altitude test conditions. Verification and documentation of successful product operation is required following the nonoperating altitude test.

3.1.3 Adjustments to Products Under Test

Adjustments to the product under test that are operator adjustments may be acceptable, depending on the allowed criteria provided according to subhead 3.2.2 or included in the product specification. In the absence of a described allowable number of operator adjustments, a maximum of six operator adjustments will be permitted during the entire altitude test program. If the allowed number of operator adjustments is exceeded, the entire altitude test program shall be repeated.

Any adjustment made that is considered a service personnel adjustment will require repeating the entire altitude test program.

Any physical repair or replacement of any component, subassembly, or assembly of the product will require repeating the entire altitude test program. See subheads 3.2.5 and 3.2.6 for media or supply replacement.

3.1.4 Product Temperature Data Requirements

It is recommended that thermal characterizations of 50 Hz and 60 Hz examples of the product be accomplished prior to these tests. These prerequisite characterizations may be based on information obtained during room ambient investigations normally performed by the product design/engineering group in their design evaluation testing. There are no requirements for temperature data within the product during these tests.

3.1.5 Media Performance and Replacement

All media (such as floppy disks, hard disks, magnetic tape, paper tape, Hollerith cards, and so forth) shall be included as part of these tests. In cases where the standard media becomes the limiting factor in classifying altitude capabilities of a product or system, the project engineer or responsible person shall note this limiting factor, and the product specification shall clearly state the limit imposed by the media.

In cases where the standard media is the limiting factor and it is intended or desired to classify and specify product capabilities in excess of the standard media capabilities, it is required that tests using extended capability media will be performed to verify this fact and to demonstrate that product operational capabilities can exceed standard media limitations by the use of special media.

In addition to the entire operating altitude program with standard media, the tests with extended capability media are required. This practice will allow an additional notation in the product specification to highlight this capability.

Media may be replaced during test conditions only if the expected media life has been exceeded.

3.1.6 Supplies and Expendables

All supplies or expendables (such as paper, ribbon, ink, and fluids) necessary for the operation of the product shall be included in these tests.

These items may be replaced during these tests only if the normal expected life or capacity is exceeded in the course of the tests.

3.1.7 Test Conditions

Subhead 3.2 defines the altitude parameters applied to the product for operating altitude exposure. Subhead 3.3 defines the altitude parameters for nonoperating altitude exposure. System configurations containing products exhibiting altitude limitations will be tested and specified at the altitude limits of the product having the minimum environmental capability.

3.1.8 Stabilized Test Conditions

Stabilized temperature conditions will be considered to exist when the product temperatures (or mean values for fluctuating temperatures) do not change more than 2°C (4°F) within a 15 minute period.

3.1.9 Variable Voltage Tests

Not applicable.

3.1.10 Rate of Temperature and Altitude Change

Rate of temperature change will not be greater than 11°C/hr (20°F/hr). Rate of altitude change will not exceed 300 m/min (1000 ft/min) as limited by a maximum pressure change of 26 mmHg/min (3500 Pa/min).

3.1.11 Raw Data Requirements

Retain all plots or tabulations of test chamber conditions, product printouts, all notebook entries of chronological test events, other product output media, and all photographs as part of the test data.

3.1.12 Substitute Tests

Formal and documented altitude tests (such as DMT, DVT, and RQT) as defined in this standard are required regardless of prior or future tests on the product. However, a test that meets all the criteria and specifications of these requirements will be acceptable even if done in conjunction with other efforts. In all cases, this acceptance is contingent upon submittal of a complete formal test report to Environmental Engineering defining all necessary parameters, results, and conclusions.

3.1.13 Test Report Requirements

A formal test report is required to verify compliance with this standard. The test report must include all pertinent test data: identification, serial numbers, calibration dates of all test apparatus and equipment; and explicit identification of product configuration including specific identification, serial numbers and revision level of all options and accessories. The altitude test report must include the ambient altitude of the test laboratory.

3.1.14 Test Chamber Criteria

The test chamber volume must be sufficiently larger than the product to allow adequate uniform circulation of ambient air. The preferred ratio of chamber volume to product volume should be a minimum of 5:1. The minimum distance between any product surface and any chamber wall or internal surface should be 15 cm (6 in).

Test chamber conditions will be constantly monitored and permanent records (graphical plots or tabulated printouts) retained as part of the test data package.

Altitude chambers with and without temperature control are allowed as defined in subhead 3.2.

The rate of temperature change shall not exceed 11°C/hr (20°F/hr). The rate of altitude change shall not exceed 300 m/min (1000 ft/min) as limited by a pressure change of 26 mmHg/min (3500 Pa/min).

3.2 ALTITUDE TEST—OPERATING

Each product or system shall be operated at a simulated altitude of 2.0 kilometers (6,562 feet) to demonstrate product acceptability in locations where high ground elevations exist. If these tests indicate altitude is a limiting factor, the project engineer or responsible person shall either take corrective action or conspicuously note this in all publications (including advertising and product data sheets) associated with the product or system.

It is recommended that thermal characterization of the product in both 50 Hz and 60 Hz configurations be accomplished prior to these tests. This characterization will allow the use of a 60 Hz unit for altitude test requirements.

Maximum allowable operating temperatures will be reduced by a factor of 1.8°C/1000 m (1°F/1000 ft) for operation at high altitude sites. For example, Class A 2 kilometer (6562 feet) altitude, maximum temperature = 76°F. See Figure 5.

3.2.1 Operating Altitude Test Procedure Using Nontemperature-Controlled Altitude Chambers

This operating altitude test will be performed for a time duration equal to the longest of the following.

- a. One and one-half hour minimum, unless product inlet air temperature exceeds the maximum temperature for the product class (uncorrected for altitude).
- b. One hour minimum following product temperature stabilization, based on product exhaust air temperature, unless product inlet air temperature exceeds rated maximum for the product class (uncorrected for altitude).
- c. Four hour maximum following product temperature stabilization and product inlet air temperature equal or less than maximum limit for the product class (uncorrected for altitude). The use of uncorrected maximum inlet temperature as a limit should allow the accumulation of reasonable altitude exposure durations from which to assess performance. The rate of altitude change will not exceed 300 m/min (1000 ft/min) as limited by pressure change of 26 mmHg/min (3500 Pa/min). The rate of temperature change will not exceed 11°C/hr (20°F/hr). Chamber test pressure will be 565 mmHg (± 10 mmHg).

3.2.2 Operating Altitude Test Procedures Using Temperature-Controlled Altitude Chamber

Operating altitude tests that are performed in chambers having capabilities to control (cool) ambient temperatures will be performed according to the procedure in Table 3.

This procedure provides verification of product performance at altitude pressure and nominal room ambient temperature, followed by a verification of product performance at altitude pressure and elevated temperature for the class, adjusted for altitude.

Maximum allowable operating temperatures will be reduced by a factor of 1.8°C/1000 m (1°F/1000 ft) for operation at high altitude sites. For example, Class A 2 kilometer (6562 feet) altitude, maximum temperature = 76°F. See Figure 5. The rate of altitude change will not exceed 300 m/min (1000 ft/min) as limited by pressure change of 26 mmHg/min (3500 Pa/min). The rate of temperature change will not exceed 11°C/hr (20°F/hr). Chamber test pressure will be 565 mmHg (± 10 mmHg).

Table 3: Test Conditions for Operating Altitude Using Temperature-Controlled Altitude Chamber

Test Condition	Dry Bulb Temperature		Altitude		Pressure		Duration Hours
	°C	°F	Km	Ft	mmHg	mbar	
Class A							
1	24	75	2	6562	589	785	2
Class B							
1	24	75	2	6562	589	785	2
2	31	87	2	6562	589	785	4
Class C							
1	24	75	2	6562	589	785	2
2	31	87	2	6562	589	785	4

3.3 ALTITUDE TEST—NONOPERATING

This test will be performed to verify that exposure to altitudes of up to 3.6 kilometers or 12,000 feet will cause no damage nor adversely affect subsequent product operation. Pressure equivalent to 12,000 feet altitude is sufficient to evaluate all air transport of the product. Regardless of actual flight altitude, aircraft internal pressures anywhere within the fuselage will be at pressures equivalent to well below 12,000 feet altitude. This pressure will be true for domestic, international, and remote local airlines. Exposure of product to this pressure will be applied for a minimum of one hour at ambient (21°C) temperature.

These tests do not address rapid decompression and the maximum allowable rate of pressure change of 600 m/min (2000 ft/min). Tests performed with an average pressure change of 52 mmHg/min (6900 Pa/min) will accomplish this rate. Chamber test pressure will be 483 mmHg (±10 mmHg).

3.4 PASS OR FAIL CRITERIA FOR ALTITUDE TESTS

The specific criteria for acceptance are as follows.

- Successful product operation throughout all operating altitude exposure.
- Successful product operation following nonoperating altitude exposure.
- No evidence of any physical defects or physical failures such as the following.
 - Leakage of fluids or gases from components or subassemblies
 - Rupture or explosion of sealed devices or housings
 - Evaporation of lubricants or other product fluids

A formal test report is required to verify compliance with this standard. The test report must include all pertinent test data: identification, serial numbers, calibration dates of all test apparatus and equipment; and explicit identification of product configuration tested including specific identification, serial numbers and revision level of all options and accessories.

3.5 OVERSTRESS ALTITUDE TEST—OPERATING

This test is required only for disk and tape products.

NOTE

Successful performance during any or all portions of this Overstress Test is specifically not required for compliance with this standard. However, overstress exposure and documentation of results is a requirement for compliance to this standard.

Following successful completion of the requirements for the operating altitude tests, operating exposures to more severe pressure conditions are required of any disk or tape product to determine operational margin and to identify a performance guard band for the product.

This overstress exposure is to be applied to the operating product according to the requirements of the normal operating altitude test except that each of the following conditions are to be applied.

3.0 km (10,000 ft)	522 mmHg	694 mbar
3.6 km (12,000 ft)	483 mmHg	642 mbar

This test is to be applied for one hour for each step or for a duration limited by the occurrence of an altitude chamber ambient temperature condition equal to the maximum corrected ambient temperature specified for the product temperature and humidity class.

APPENDIX A REFERENCED DOCUMENTS

A.1 EL-Class Digital Documents

EL-Class Number	Document Title
EL-00045-01	<i>DEC STD 045-1 Packaging Products for International Shipment - Design Requirements and Procedures</i>
EL-00092-04	<i>DEC STD 092-4 Finish and Color Standard—Approved Finish Specifications</i>
EL-00102-00	<i>DEC STD 102-0 Environmental Standard for Computers and Peripherals—General Test Requirements</i>
EL-00122-00	<i>DEC STD 122-0 AC Power Line Standard: Design Requirements and Guidelines</i>
EL-SM092-00	<i>Finish and Color Standards Manual</i>

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